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and
Its Application to Paint

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THE NEW JERSEY ZINC SALES COMPANY

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Zinc Oxide and Its Application to Paint

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THE master painter has always been on the alert to see that the material he bought has worked right and has given satisfaction to his customer, the property owner. Competition has constantly stimulated his interest, so that now he reaches out for more fundamental information about his materials, believing that the more he knows about paints, the better able he will be to select the best type for each particular job.

I shall try to give you pertinent information and illustrate a few facts in such a way that the points you may have heard about, but which may be somewhat obscure, will become realities to you. They will concern Zinc Oxide, sometimes known as "Zinc White," in its particular application to paint.

Zinc Oxide is a paint pigment. The layman unfamiliar with paint technology thinks of a pigment as coloring matter. Actually, a pigment is any insoluble matter added to the vehicle (either an oil, turpentine, liquid drier, clear varnish, a mixture of these, or a clear lacquer) to give the paint color or opacity. The dark pigments, such as reds and greens, are used as the pigment base for dark paints, but the white and light tinted paints which are so largely used today are based on white pigments. Such pigments protect the vehicle and give it longer life, and the properties that each pigment adds to the paint are dependent upon the characteristics of that pigment. Zinc Oxide gives very desirable qualities to paints, as will be described hereafter.

To begin with, Zinc Oxide is merely "Zinc Smoke." There are two types of Zinc Oxide designated according to the process by which each is made. One is "French Process Zinc Oxide" which many painters know as "French Zinc." This is produced by vaporizing the slabs of zinc metal in a furnace, then burning the zinc vapors by letting them come in contact with oxygen in the air. The "smoke" is collected, graded, and packed for shipment as French Process Zinc Oxide. Many thousands of tons are produced in this country every year, commonly in three grades: "White Seal," "Green Seal," and "Red Seal."

This process can easily be illustrated with a piece of zinc foil—zinc metal

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that is rolled out into a sheet about four-thousandths of an inch thick. In this form it will burn readily on applying a match. The zinc metal burns with a green flame, forming the oxide, and the white smoke going off into the air is virtually French Process Zinc Oxide.

"White Seal," "Green Seal" and "Red Seal" French Process Zinc Oxides are very fine, white, and very bright. They are used to make up the finest grades of white and tinted enamels and lacquers, and are frequently used in conjunction with Lithopone, Cryptone (high Zinc Sulphide Lithopone), and titanium pigments to increase lustre and smoothness in mill whites and

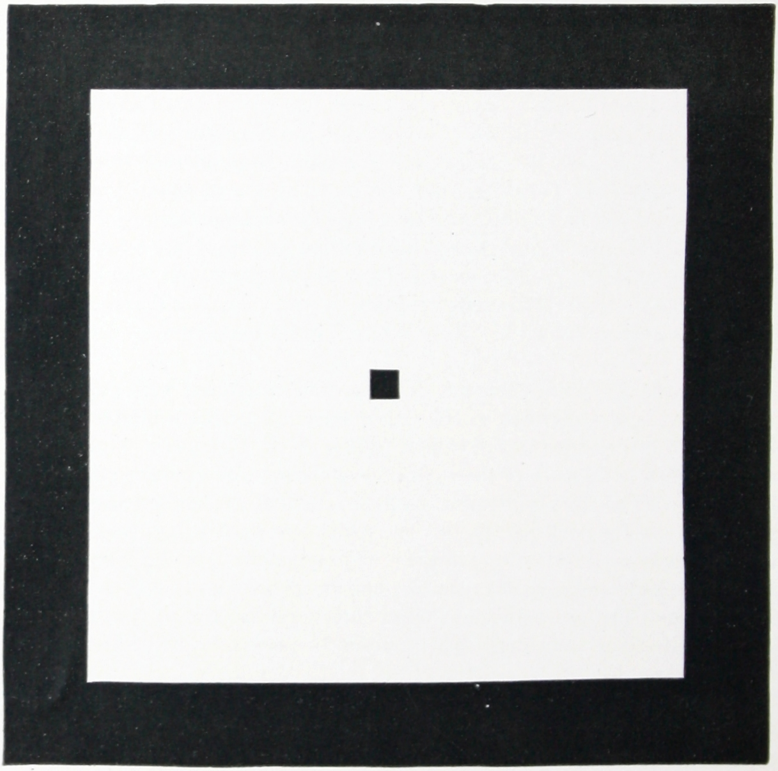

FIGURE 1

Above chart indicates relative size of Zinc Oxide Particle (represented by small square in center) to space between wires of 300-mesh screen other finishes. In flat wall paint and undercoaters, in conjunction with Lithopone, they add a desirable degree of hardness and help to prevent hard settling in the can.

The other type of Zinc Oxide is known as "American Process Zinc Oxide." Instead of first producing zinc metal and burning that, the ore is converted into Zinc Oxide direct. Crushed ore and powdered coal are mixed and burned in a furnace, and the resulting zinc "smoke" is likewise collected and becomes the American Process Zinc Oxide of commerce. This process was developed within the organization of The New Jersey Zinc Company.

American Process Zinc Oxide is the one so largely used in outside house paints. Its characteristics are fineness, whiteness, brightness, hiding power, oil absorption and reactivity with oil—all found to a desirable degree.

Being a condensed "smoke" or fume pigment, Zinc Oxide is very fine in particle size; in fact, it is the finest white paint pigment made (see Fig. 1 on opposite page and Figs. 2, 3 and 4 on following pages). It is obvious that in order to spread an even, uniformly smooth film with a brush the paint must contain no particles large enough to be seen by the unaided eye; and it can readily be understood that *the finer the particles the smoother the surface produced.*

Zinc Oxide is so fine that the highest power microscope must be used in order to see the outline of the individual particles. This, together with its excellent color, brightness, and its ability not to interfere seriously with the gloss and flow of the vehicle, enables the paint manufacturer to make a long oil white enamel for interior use that levels out with a smooth "plate-glass" finish, free from pebbliness and imperfections.

The difference between a "plate-glass" finish and a "pebbly" one can be represented by the two exaggerated charts shown on page 8. In the first (Fig. 5), the oil covering the even pigment layer lies smoothly over the Zinc Oxide particles. In the second (Fig. 6) smoothness is interfered with in three ways:—(1) by bunches of particles that have not become separated during the manufacture of the enamel; (2) some large particles of pigment other than Zinc Oxide; and (3) the lack of proper flow, resulting in brush-marks or an uneven surface. Zinc Oxide in enamels reacts or combines to some extent with the vehicle, yielding a lustre that lasts for a long time.

There are two properties which Zinc Oxide has that are unique and which are absent from all the other opaque white pigments. The first is the ability of Zinc Oxide, when mixed with raw or refined linseed oil, to yield the proper hardness. The second is its ability to prevent the passage of the destructive ultra-violet light rays present in sunlight. It is these properties, together with the good suspension qualities of Zinc Oxide, that have led

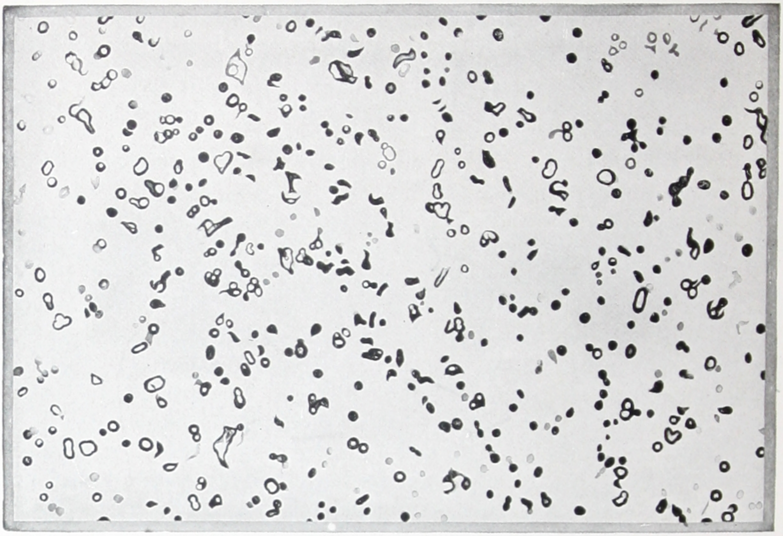

FIGURE 2
*"XX Black" Zinc Oxide Particles magnified to approximately 2,700 diameters

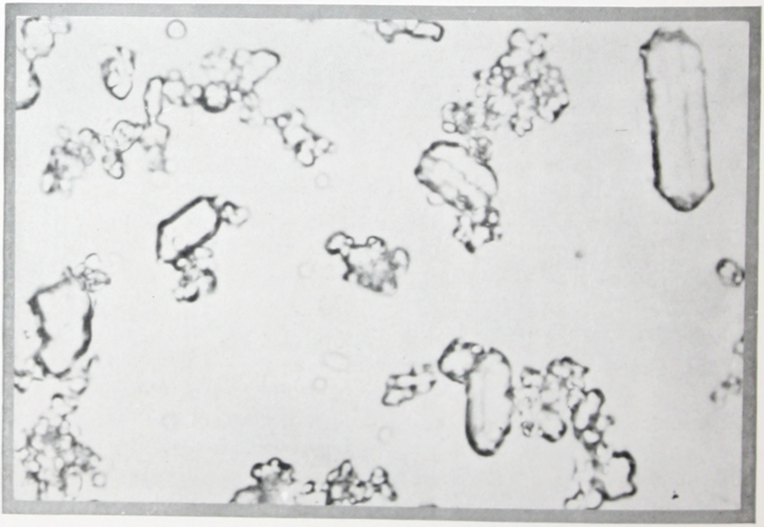

FIGURE 3
*Corroded White Lead Particles magnified to approximately 2,700 diameters

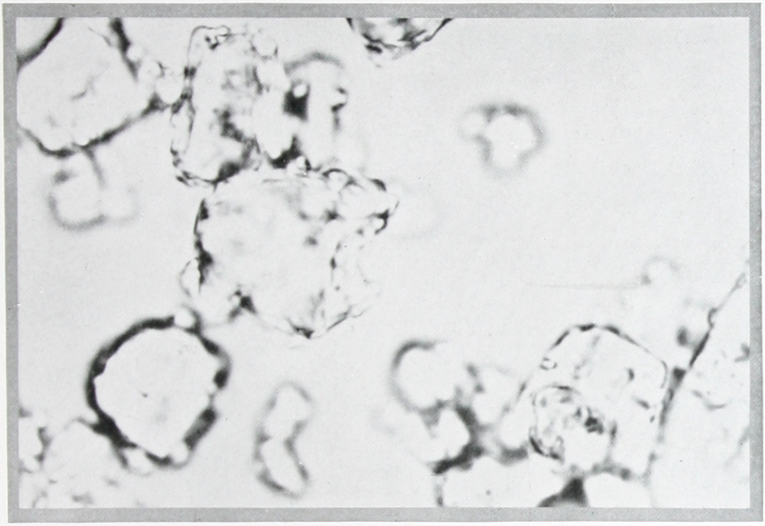

FIGURE 4

*Barytes Particles magnified to approximately 2,700 diameters

paint manufacturers to practically universal inclusion of this pigment in outside house paints. Both of these properites influence the life of the paint film and have their bearing on chalking, which is the first indication of a paint film's destruction.

Can we get a clear idea of just what chalking is? Suppose we were to call it "rusting." When iron rusts, it takes up oxygen from the air, forming iron oxide which powders off, leaving less iron. The oil in the outer surface of the paint film likewise takes up oxygen from the air, disappears and exposes the bared pigment which in turn becomes loosened at the surface and weathers or rubs off. The ideal condition would obtain if neither the iron nor the paint film would "rust," provided nothing else happened. But a strictly "rustless" or, better speaking, non-chalking house paint, that is satisfactory in every other way, has never been developed. The best science has been able to do is to slow up the rate of chalking as much as possible, and yet have the paint fail to a repaintable surface. This is exactly what the paint manufacturer accomplishes when he balances up his paint with Zinc Oxide. The "harder drying" Zinc Oxide compensates for the other "softer drying" pigments—Lithopone, white lead, titanium pigments—and does not let the film chalk away as fast as would happen were the Zinc Oxide not there.

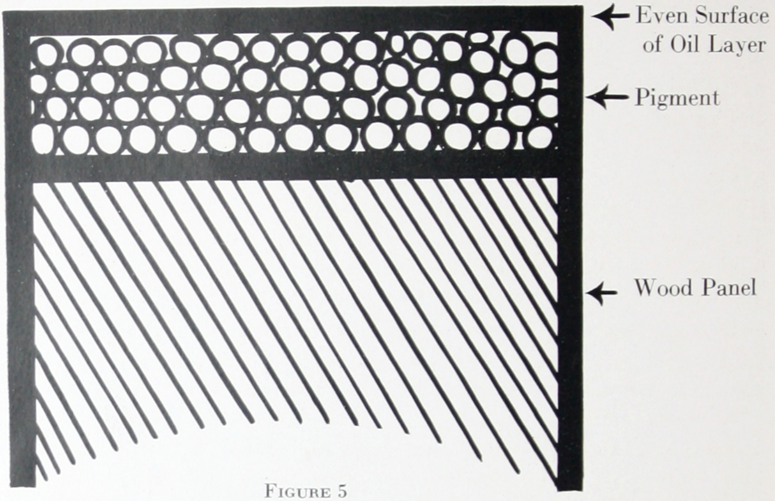

Figure 5

Enamel made from French Process Zinc Oxide showing "Plate Glass" Finish

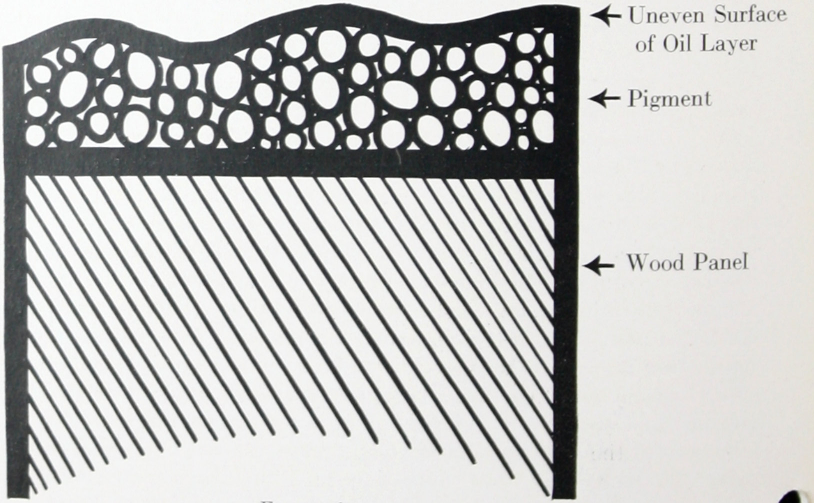

Figure 6

Enamel made from other White Pigments showing Pebbliness

The second of the properties possessed by Zinc Oxide, alone of all opaque white pigments, is its ability to stop and absorb ultra-violet light rays.

You have heard about these rays. They are present in sunlight and are the portion of the latter which is the most active in tanning the skin, bleaching dyes, et cetera. They are powerful, and a destructive enemy of paint.

You know how the X-rays can penetrate some things—flesh, completely; bone, not so well; and thick metal, not at all. X-rays are different from the sun's rays but, in the same way that the X-rays will penetrate flesh and be stopped by thick metal, the ultra-violet rays will penetrate basic carbonate white lead, but Zinc Oxide practically not at all.

If we make accurate measurements, we find that basic carbonate white lead and Zinc Oxide are opposites, in that the former lets the ultra-violet light pass through practically 100%, whereas Zinc Oxide lets practically none go through.

What of all this? We know that as oil approaches complete oxidation it loses its flexibility, and that the rate of oxidation is stimulated by ultra-violet rays. If the rays are stopped at the surface of the film, they can do no damage to the oil under the surface. If they pass through, then the whole depth of film will be affected and sent more rapidly on the road to destruction.

Have we proof that the ultra-violet light will make oil perish ahead of its time, or is this only a fine theory? Note the three panels "A," "B," and "C" on pages 10, 11 and 12. Panel "A" was painted with three coats of a typical outside house paint vehicle—raw linseed oil, turpentine, and drier. Panel "B" was painted with the same liquid, to which basic carbonate white lead was added. Panel "C" is the same as "B," except that the added pigment consisted of 65% basic carbonate white lead and 35% Zinc Oxide. In other words, panels "B" and "C" were given three coats of typical outside white house paints. All three panels were covered halfway by something that would let the visible light rays of the sun pass through, but would stop the ultra-violet rays. That "something" was ordinary window glass. Daylight that had been made extraordinarily destructive through increase of the natural ultra-violet light by artificial means was allowed to shine on the panels for 144 hours, and you can see the result. The exposed part of panel "A" (Fig. 7) has "crazed" (cracked and checked), flatted and lost its tackiness (stickiness). The visible effect on panels "B" and "C" is that both have chalked because the surface layer of vehicle has perished, but "B" (Fig. 8) has chalked more than "C" (Fig. 9), as was shown by rubbing a black cloth over both. You will see that there is more white on the cloth rubbed over panel "B," now shown draped over one edge.

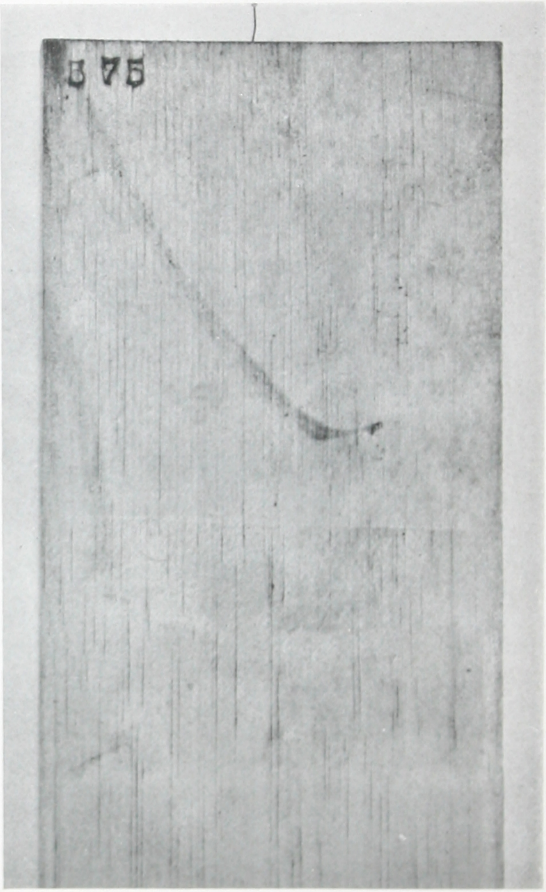

FIGURE 7

PANEL A. Coated with 3 coats house paint mixed vehicle—raw linseed oil, turps and drier. Upper half exposed for 144 hours to daylight with ultra-violet light increased by artificial means; lower half treated in same way, but with the ultra-violet eliminated by covering with ordinary window glass. (The photograph does not show the dead flat on the upper half caused by the destructive ultra-violet light.)

FIGURE 8

PANEL B. Painted with 3 coats 100% Basic Carbonate White Lead house paint. Depth of white spot on black cloth in upper right corner indicates extent of chalking (Compare with panel C, fig. 9).

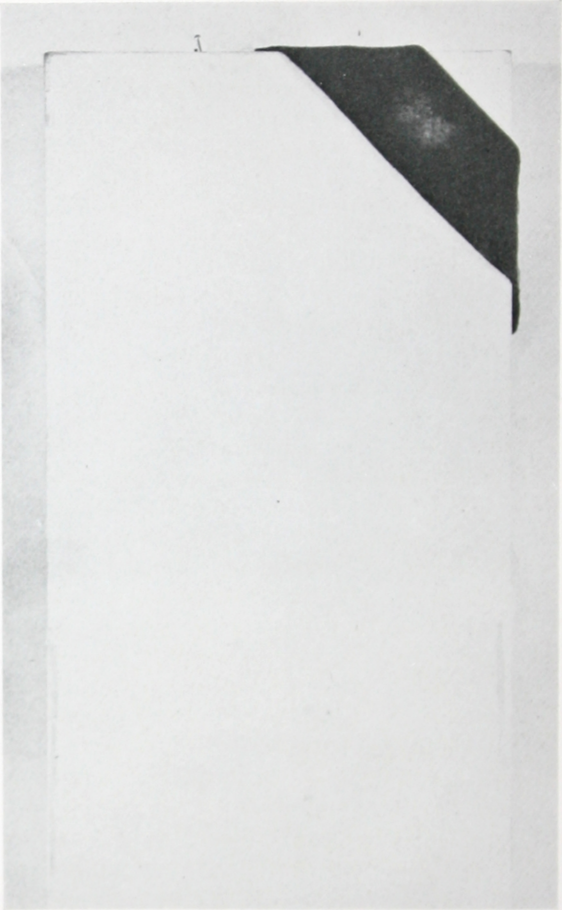

FIGURE 9

PANEL C. Painted with 3 coats 65% Basic Carbonate White Lead and 35% Zinc Oxide house paint. (For chalking compare quantity of white on the black cloth with panel B, fig. 8.)

Such conditions are found because the ultra-violet rays have penetrated the straight lead paint film deeply, more oxidation of oil has occurred, and more of the pigment particles have been left without oil to bind them. The Zinc Oxide in the paint on panel "C," on the other hand, stopped the rays to a great extent, laying bare only the pigment particles on the very surface, and allowing less of these pigment particles to rub off. This is good evidence that not only is our theory correct, but that ultra-violet light is destructive—and is rendered less harmful to the paint film by the addition of Zinc Oxide. ✓

Please note "the addition of Zinc Oxide." In the present state of our knowledge of oils, driers, and pigments, house paints are not made with Zinc Oxide as the sole pigment—at least not for general use in the United States. On the Continent of Europe, such paints are successfully used. Here, the other pigments in the paints—Lithopone, white lead, titanium pigments, etc.—have their very useful functions.

✓ In the dry state, Zinc Oxide is extremely white, that is, it has "good color." Mixed with linseed oil, it still retains its whiteness. This means that it has hiding power. Inert pigments, for example whiting, are white when dry but when added to oil the mixture has a muddy yellow color. Whiting and linseed oil yield putty, and putty thinned out to brushing consistency will not yield a white paint. This matter of hiding power or lack of hiding power is the chief difference between the opaque white pigments—namely, the zinc pigments (Zinc Oxide, Zinc Sulphide, Lithopone, and high Zinc Sulphide Lithopone), the titanium pigments and white lead—and the inerts (whiting, silica, barytes, magnesium silicate, calcium sulphate, and clay). This list comprises practically all the white pigments that go into white and tinted paints. In hiding power of the dry pigments Zinc Oxide is weaker than Lithopone and stronger than white lead.

It takes a certain quantity of oil to wet a pigment and bring it to painting consistency. This property is called oil absorption or oil-taking property, and pigments vary in the proportions which each will absorb. Zinc Oxide has a relatively high oil absorption, which offers the opportunity to add:—(1) not too little oil for durability, and not too much, which might cause improper drying; (2) enough turpentine to get working body when the right proportion of oil for durability and good drying has been added. Exact figures cannot be given, as requirements vary according to pigment composition, condition of surface, and climatic conditions. By correct balance of the thinners we obtain the desired hiding power, durability, and gloss, even though a pigment of relatively high oil absorption is present in the paint in substantial quantities. ✓

A strong, well-knit paint film is the result of a firm bond between the pigment and the oil. In order to obtain this firm bond, there must be a favorable reaction between the pigment and vehicle that will produce soaps, and through them tie the oil and pigment together better. In exterior white house paints, some of the pigments used do not react with the oil. Others do, but their soaps lack some desirable qualities. The soaps formed through the reactivity of Zinc Oxide give the desired degree of hardness, also incidentally yield lustre and, in the can, promote suspension of the pigment. Thus the reactivity of Zinc Oxide improves paint in several ways besides adding to its life.

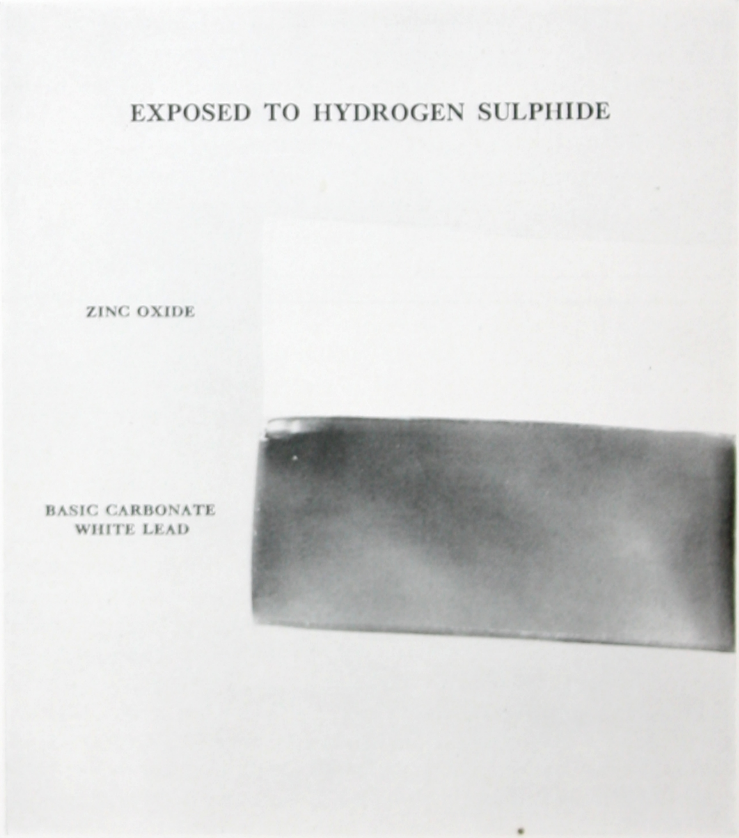

Figure 10

Two other important points in favor of Zinc Oxide have not been mentioned. It does not darken when exposed to the gases present in the air of industrial cities and in the vicinity of harbors and rivers which contain town and city drainage. In tinted paints Zinc Oxide stabilizes the color, whereas when it is absent such tints may darken from exposure to gases or may fade from excessive chalking.

The gas in smoke that does more to darken paint than any other is hydrogen sulphide. Figure 10 shows two pigments which have been rubbed up to a paste with linseed oil. One is basic carbonate white lead and the other Zinc Oxide. They have been exposed to hydrogen sulphide gas for

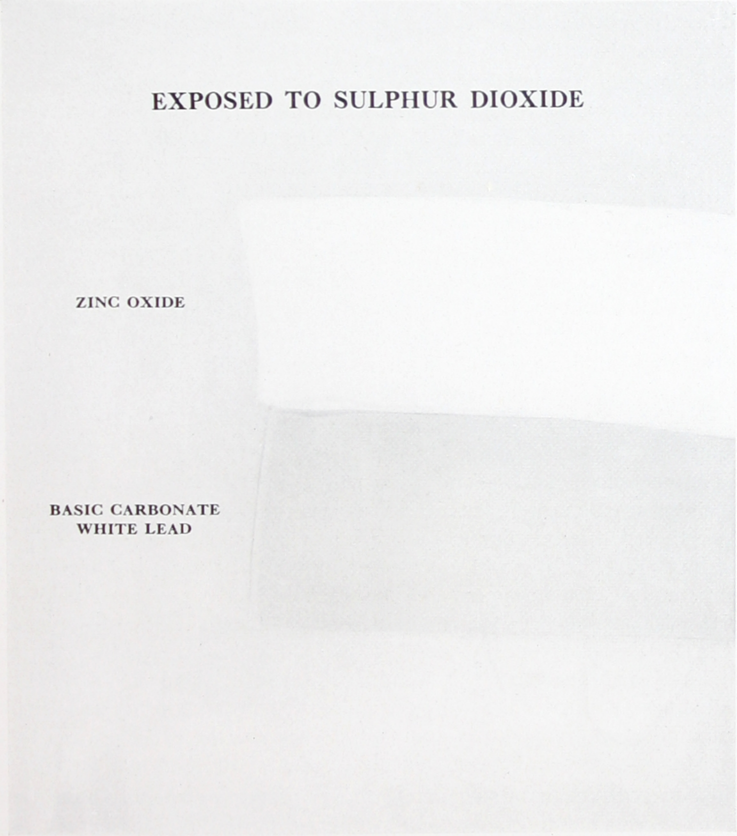

FIGURE 11

only a few minutes. The basic carbonate white lead has turned black, but the Zinc Oxide remains white and unchanged. Figure 11 shows the same materials exposed to sulphur dioxide, another gas present in all communities. Again the basic carbonate white lead lost its color and turned dark, while the Zinc Oxide retains its remarkable whiteness.

The presence of Zinc Oxide in paint either prevents or greatly lessens the formation of mildew, so that less discoloration occurs in warm, damp places, as along the seacoast and in Southern communities. Mildew is most commonly observed upon paints which remain soft in such climates. When certain kinds of dried plant spores and vegetable matter are blown against such paint it acts like flypaper and retains the spores, offering fertile soil for the spores to grow and spread in the customary manner of fungus, and discolor the surface.

The two-fold protection afforded under these conditions by Zinc Oxide in paint is graphically shown by these panels (Fig. 12), which have been exposed in the warm, humid climate of our Gulf Coast for about two years. The paint on the left-hand panels, containing no Zinc Oxide, has chalked badly, leaving the wood beneath without adequate protection. Mildew has become firmly established on this softer surface, which gives the surface a dirty, unattractive appearance. A substantial percentage of Zinc Oxide in the paint on the right-hand panels gives the proper hardness to the paint film, thus both eliminating premature chalking, and preventing the formation of mildew. The clearness and brightness of the color of the paints containing Zinc Oxide were very noticeable when approaching the actual tests from a distance.

Today the advantages of painting stucco, concrete and brick are just beginning to be appreciated. Moisture and dirt can do as much damage to unpainted stucco homes—and to concrete industrial structures—as to unpainted wooden dwellings. The drabness—the discolored appearance—of weathered stucco is due to its rough and porous surface which collects and holds dirt. Water will not cleanse unpainted stucco, but remains in the pores to cause dampness and stains. A protective coating of paint decreases the possibility of the concrete or stucco from spalling off (cracking off or splitting off) from the action of the frost in freezing weather. Examples have been seen where this dampness has caused the decay of wood behind stucco, and there are other examples of the rusting of metal lath and structural steel, matters which have not received the consideration their importance deserves. Proper painting eliminates these serious hazards.

The present vogue for color has led many property owners to paint their stucco or brick buildings. The opportunities for artistic coloring are infinite —various tints and combinations of color make the painted stucco home a

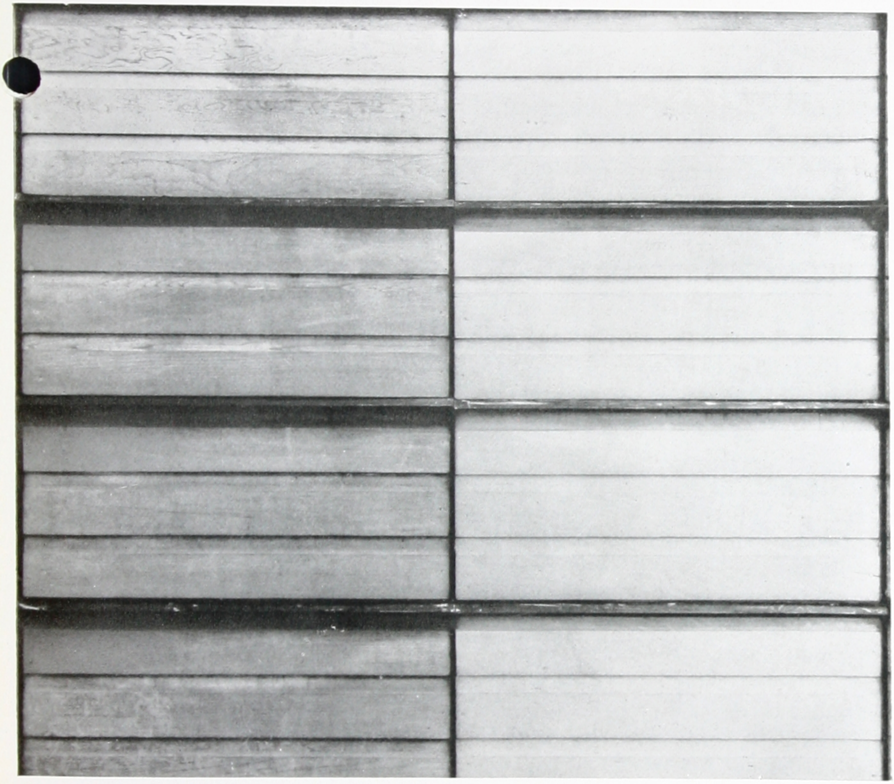

FIGURE 12

thing of individual beauty and charm. Dry color mixed with stucco, or a finishing coat of water paint, merely adds color—neither can protect the surface.

For painting cement and stucco surfaces a properly designed primer should be used that will resist the action of the alkali. Such primers are made by a number of paint manufacturers. In many cases—and especially on new concrete or stucco surfaces—a wash (4 pounds of Zinc Sulphate to the gallon of water) should be used to neutralize the alkali before any painting is done. This should be followed by the finish coat paints which are used when painting wooden structures. Paints which are especially suitable for painting such surfaces contain substantial proportions of Zinc pigments—such as Zinc Oxide and Lithopone—combined with the proper oils and driers. Zinc Oxide gives to the paint the greatest degree of imperviousness to moisture, and the durability expected of high-grade paints.

✓ Just a word on the painting of structural steel, bridges, buildings, tanks, and so forth. Here the priming coat is of paramount importance. We want the paint to last, to retain its toughness and to prevent rusting. We have repeatedly proved by test that, when such paints are made with iron oxide or red lead, longer life results from the addition of Zinc Oxide, and such paints are being marketed with success. For the industrial painting of The New Jersey Zinc Company—we have hundreds of buildings, tanks, frameworks, et cetera, in different parts of the country—we have standardized on a paint made from Metallic Zinc Powder and Zinc Oxide. Such paint is recommended for protecting iron and steel in ordinary service, for protecting the interiors of steel water tanks (particularly where the water used carries much dissolved or suspended matter) and as a primer for galvanized iron or sheet zinc. We are getting better and more lasting jobs, and our results have been so good that the use by others of this relatively new paint is growing rapidly and is of much interest to paint manufacturers and paint consumers.

Let me summarize the combination of qualities that Zinc Oxide possesses —fineness, permanent whiteness, brightness, clearness and retention of tint, hiding power, oil absorption, reactivity with oil; and two very important properties held by no other opaque white pigment: (1) The ability to make a harder, firmer paint film when combined with raw or refined linseed oil, and (2) absolute opacity to ultra-violet light.

Outside white house paints made without Zinc Oxide may be white and have other good properties, but will always lack those desirable qualities that Zinc Oxide alone can give.

How has this fact been reflected in the painting industry?

First—The master painters who keep abreast of the times by reading, studying, and attending these meetings, agree that the presence of Zinc Oxide improves all white and light colored house paints.

Second—This same conclusion has been arrived at by technical societies, trade associations, government departments, and paint technologists.

Third—There are about 500 paint manufacturers in the country, most of whom make outside white house paints. Of these, I know of none who omit Zinc Oxide from their paints—ready mixed and semi-paste—a jury decision in favor of its use. An actual recent check-up of the best known brands made by the most prominent manufacturers shows that the average proportion of Zinc Oxide in the pigment portion is 33%. The proportion is not the same in different paint manufacturers' products and may run as low as 20% and as high as 60%, but it is always present.

In many interior flat and gloss paints, enamels and lacquers, and in industrial coatings, Zinc Oxide is demanded on account of qualities no other pigment can impart.

Such is the position of Zinc Oxide in the paint world—the world you are most interested in. Our eighty years of association with the paint industry and its problems have enabled The New Jersey Zinc Company to have a complete understanding of the needs of the Industry, and to make Zinc Pigments of the characteristics and qualities most desirable for paints.

The New Jersey Zinc Company is the oldest manufacturer of Zinc Pigments for paint in this country, and the only one manufacturing the complete line—French and American Process Zinc Oxides, "Albalith" Lithopone, Cryptone (high Zinc Sulphide Lithopone) and Zinc Sulphide. Complete control of production is in The New Jersey Zinc Company from the mining of the ore to the shipment of the finished pigments which you know. This constant supervision insures the uniform quality for which The New Jersey Zinc Company's products are noted—uniformity which means reliable performance in the paints you buy. When The New Jersey Zinc Company's Pigments are used in paint you can know that the manufacturer has chosen his pigments intelligently.

ZINC OXIDES

FOR more than three-quarters of a century The New Jersey Zinc Company's Zinc Oxides have been noted for their quality and uniformity.

Enamels of highest grade are made with The New Jersey Zinc Company's "Florence Brand" French Process Zinc Oxides. The reputation and performance of these finishes are largely due to this fact.

The reputation of high-grade prepared house paints was made with Horse Head "XX" Zinc Oxide, produced by The New Jersey Zinc Company. Paint manufacturers have not found any superior oxide.

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